
Preliminary study on the RHC two-track events with 1cm-cube.

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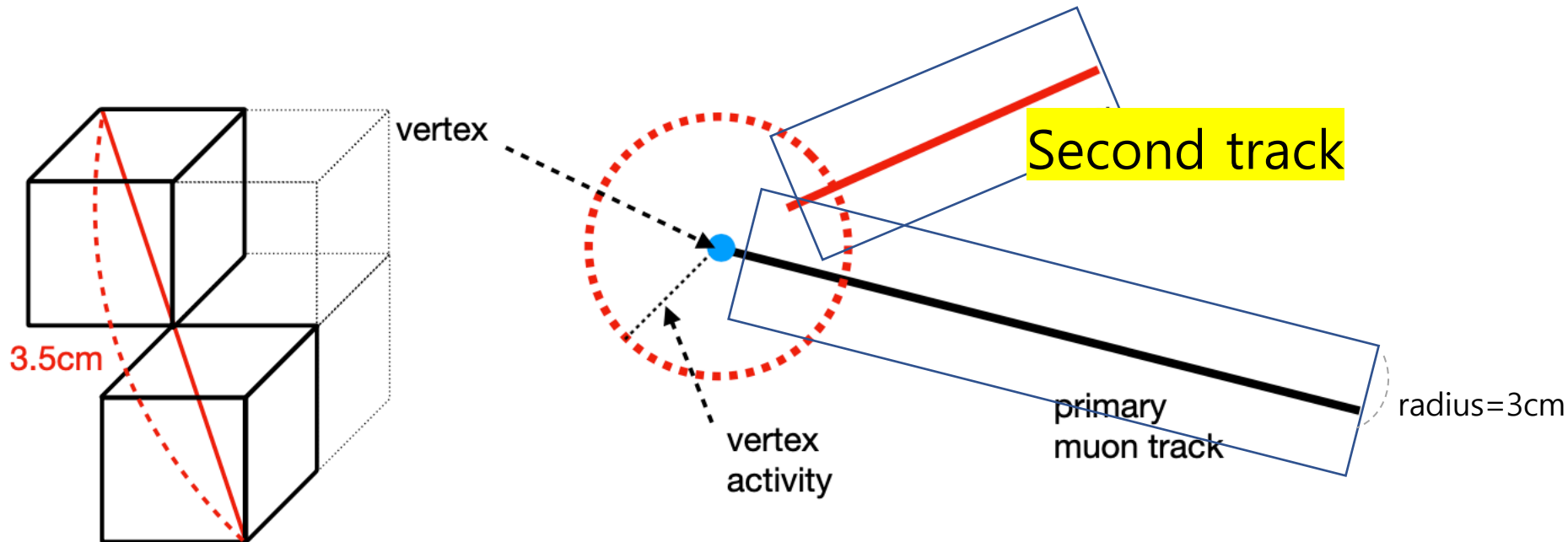


Outline

- We've been looking at the single track event. And now we move to look at the two-track event.
- Our goal is to select $CC1\pi^\pm$ and it requires two-track within the vertex region.
Also we assume we can select muon.
- First, we need to separate proton and pion as the second track.
- After identification between pion and proton, we can start to neutron selection.

Select the two-track events

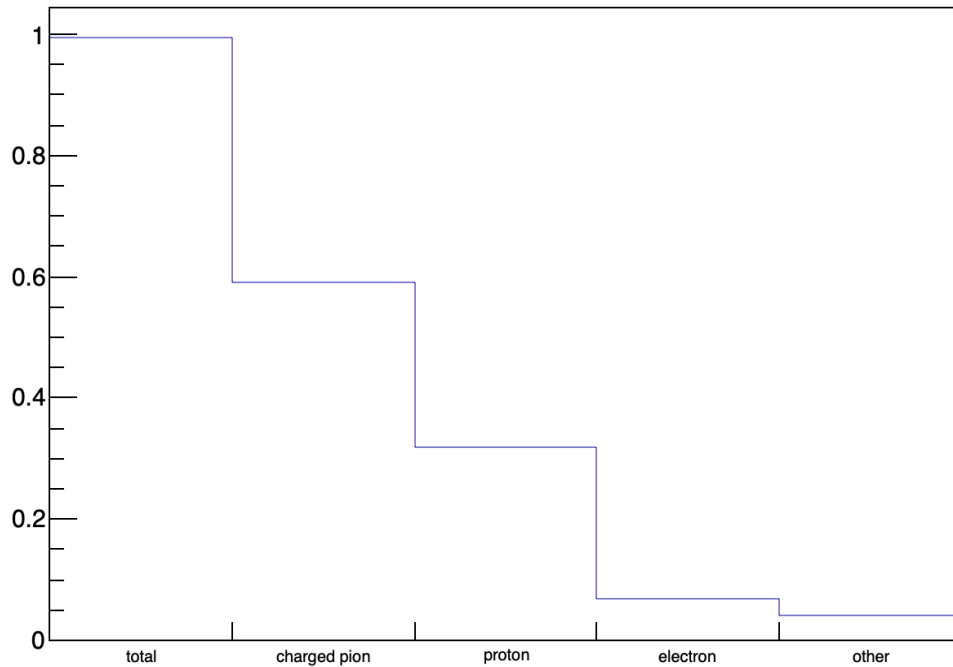
- We consider muon track starting point as vertex point.
- We can obtain two-track events by counting the number of track within vertex activity.
- Then, we can identify proton and pion.
- We try to find neutron-induced candidates, i.e, first isolated object in time.
- We apply cylindrical cut along both tracks, intending to find isolated objects.



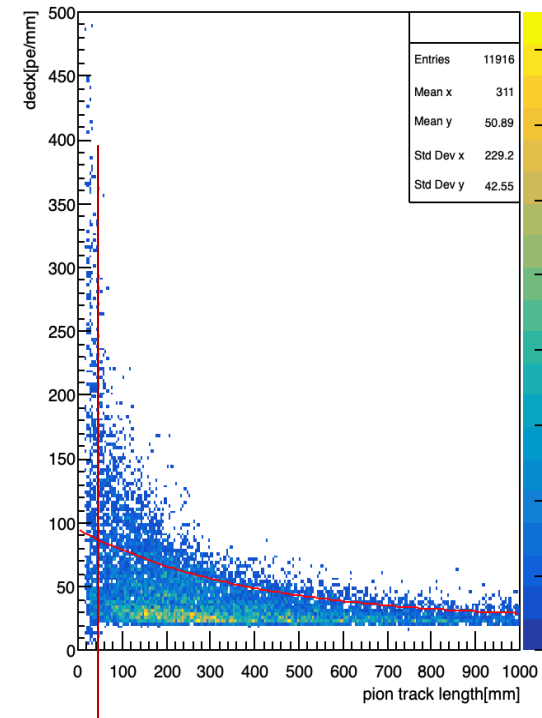
[From sunwoo's talk]

Identification between proton and charged pion

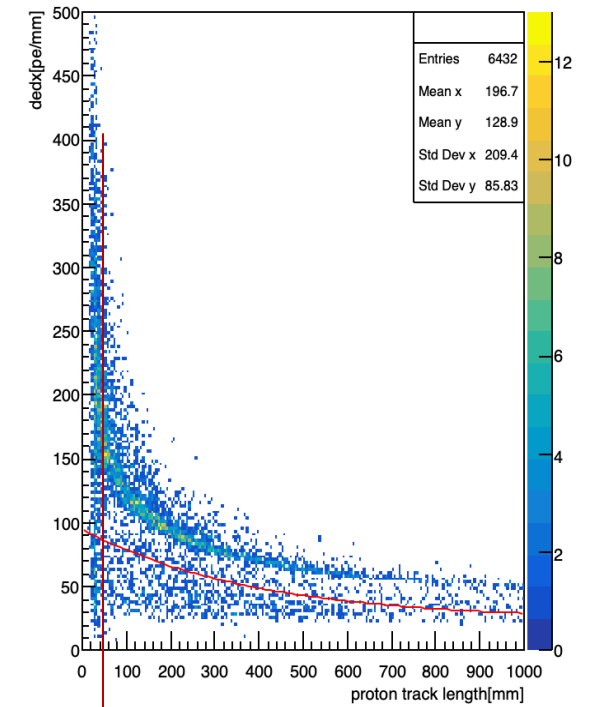
SecondTrack PDG



charged pion

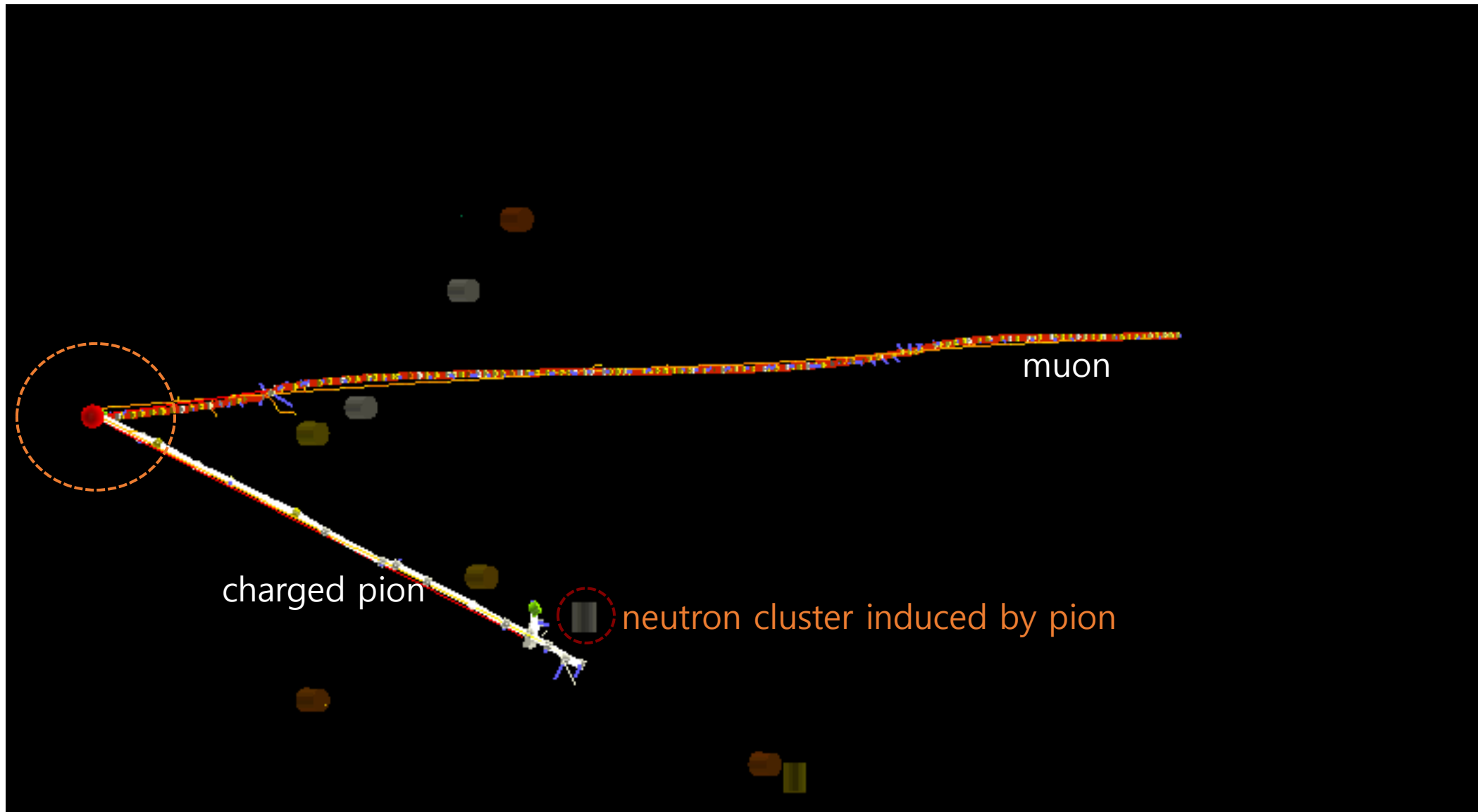


proton



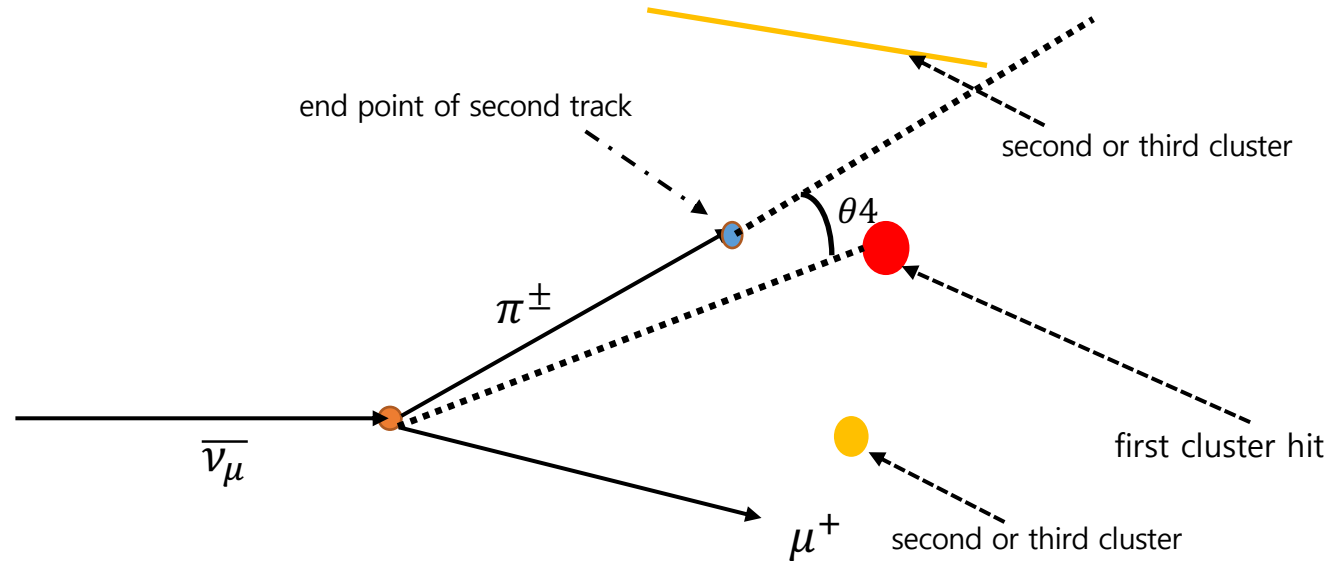
- The majority of second track is pion or proton. We assume electron and π^0 can be identified.
- After $dedx$ +track length cut, We can get 90% purity of pion and 74% efficiency from the proton and pion events.
- I checked the second track's angle and momentum after cut, there is no any critical phase space loss.

Event display



Make variables

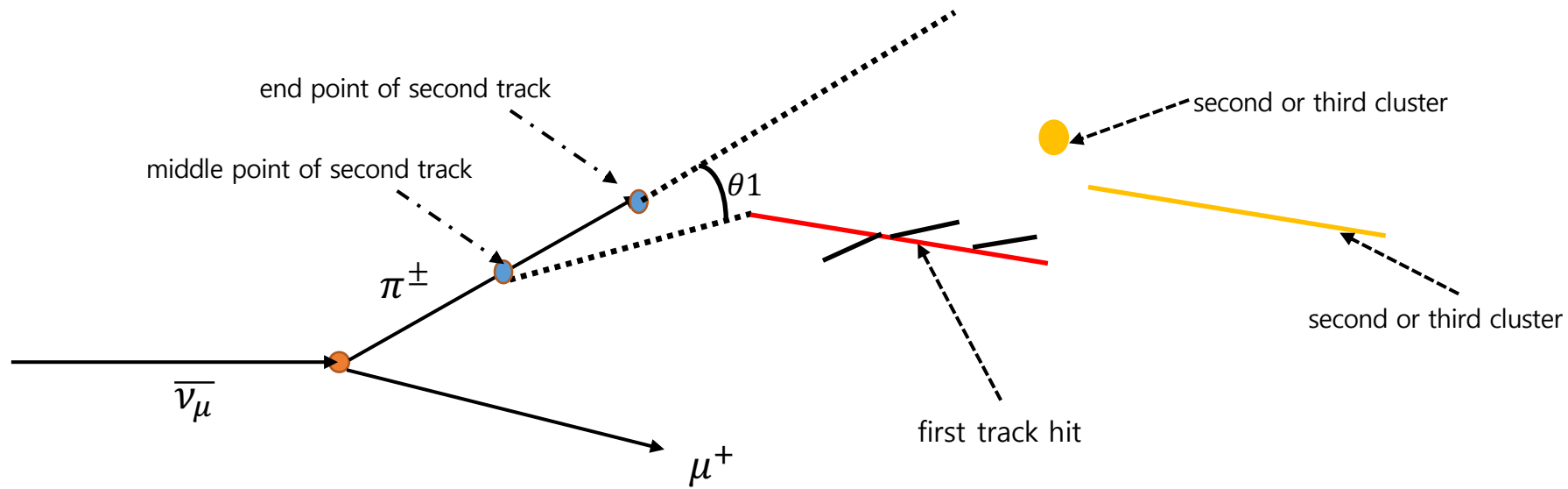
- Signal means primary neutron or first object hit induced by primary neutron.



If first object is cluster,

- 1) Energy deposit
- 2) Angle4 (angle between first hit direction and second track direction)
- 3) Distance between end point of second track and first object
- 4) Distance between nearest track and first object

Make variables

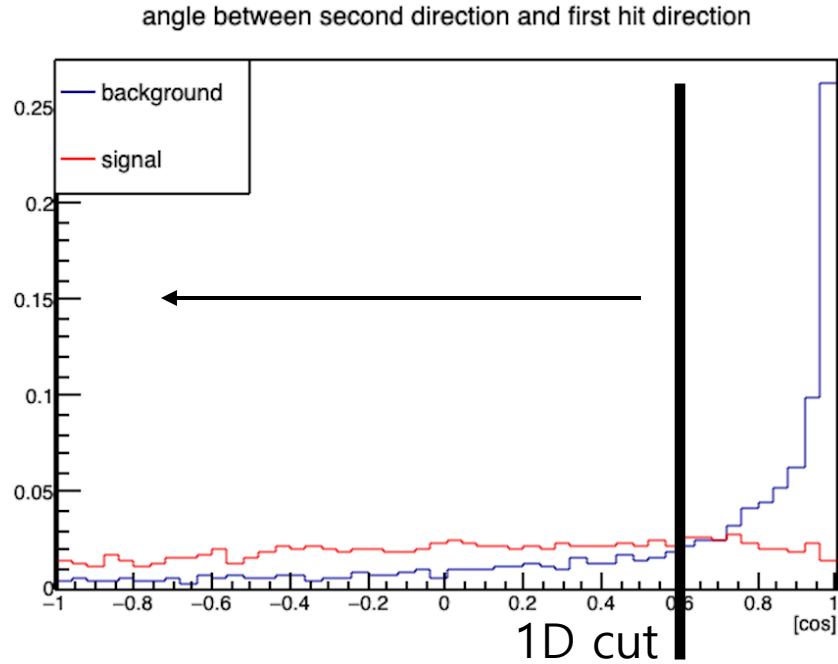


If first object is track,

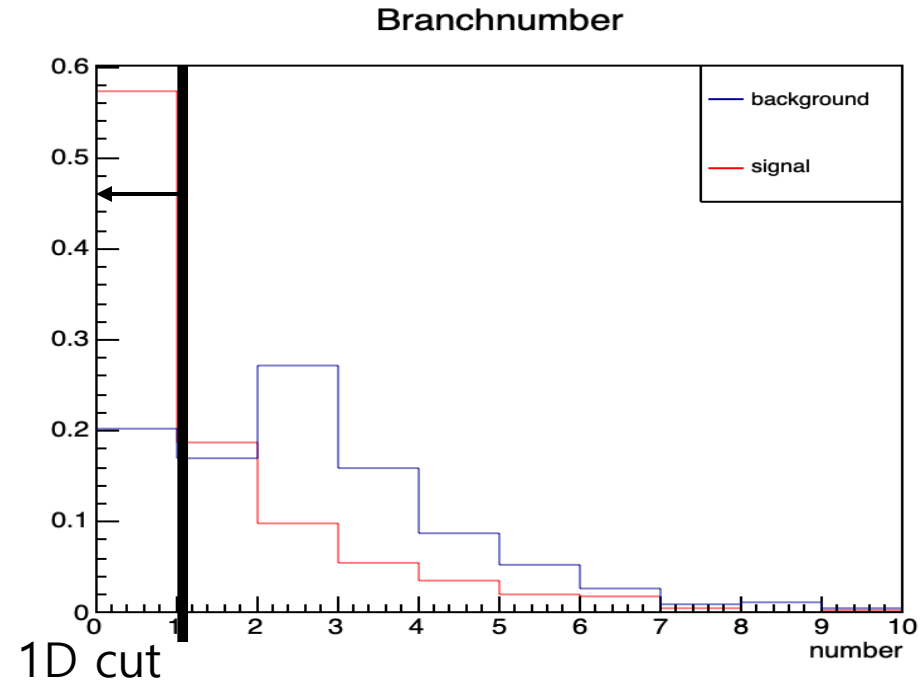
- 1)Energy deposit
- 2)Angle1(angle between second track direction and direction of middle point to first hit)
- 3)Track length
- 4)Neighbor distance
- 5)Branch number

After Selection

For cluster



For track



After applying the 1D cuts,

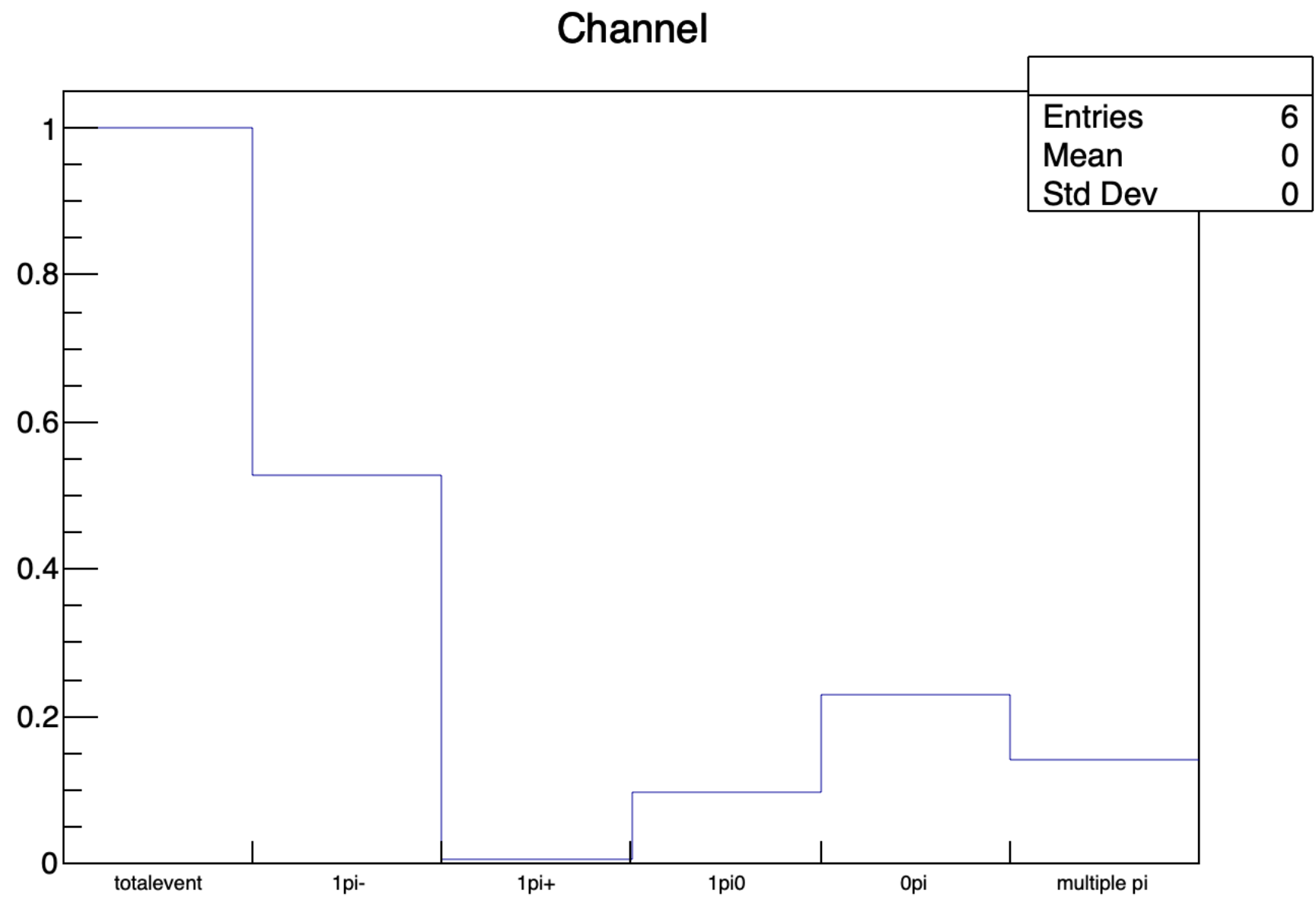
- For track, we can get 90% purity and 24% efficiency.
- For cluster, we can get 88% purity and 21% efficiency.
- I checked the whether there is critical phase space loss.
(Neutrino energy, neutron kinetic energy, muon momentum, Q2, Q3, lepton angle, lepton momentum)₈

Summary

- We can identify pion out of proton and pion events with 90% purity and 74% efficiency.
- After apply 1D cut with a couple of variables, we can make neutron signal events with around 90% purity and 20% efficiency.
- Next, we'll move on $1\pi^0$ channel selection.

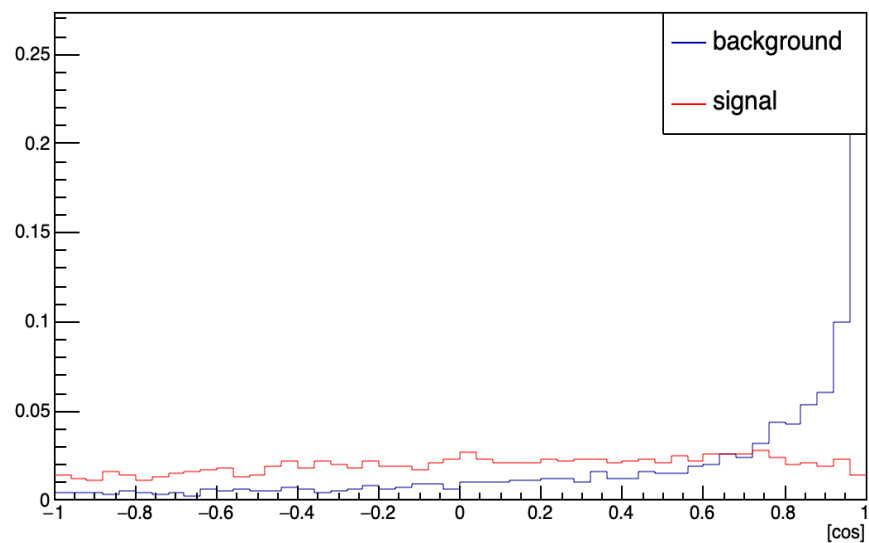
Back up

Channel fraction on the two-track

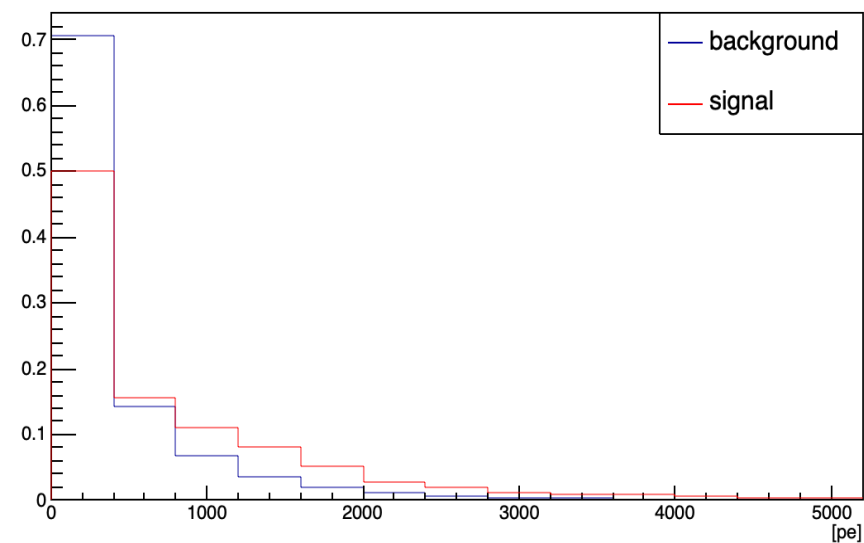


variables for cluster

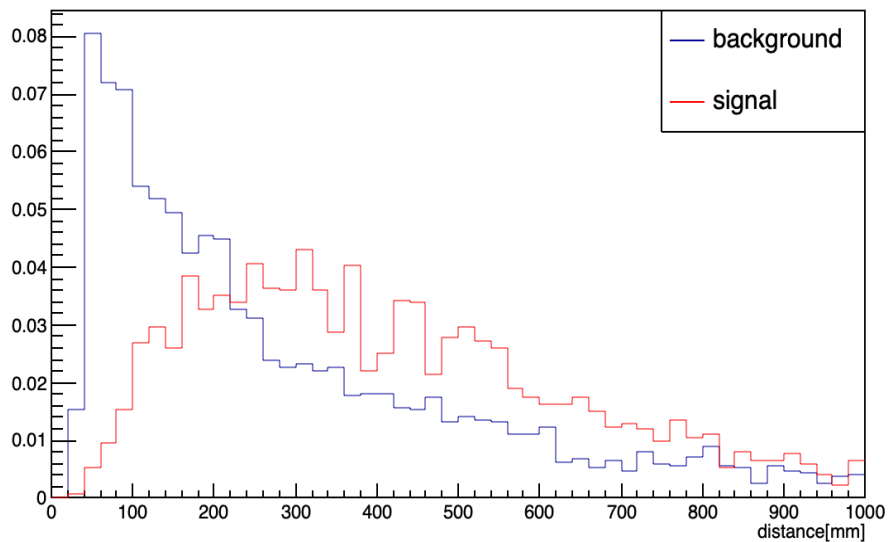
angle between second direction and first hit direction



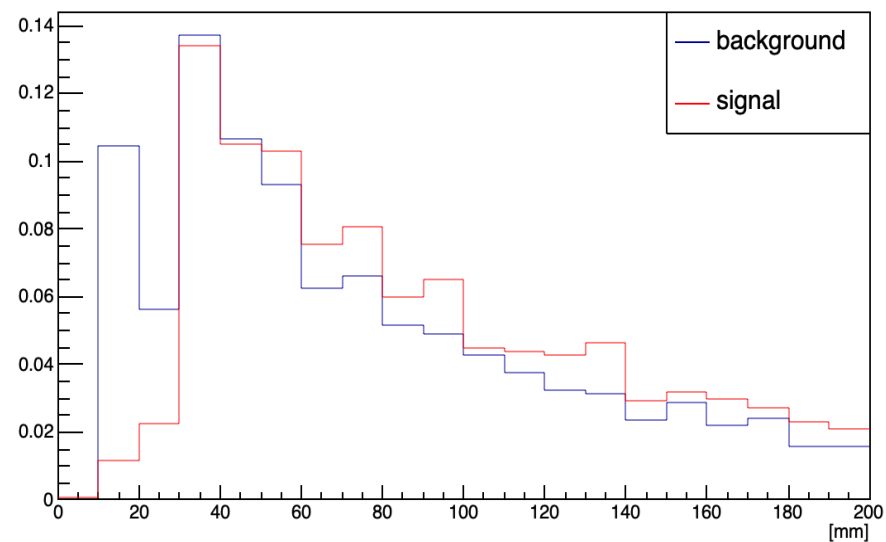
eDep



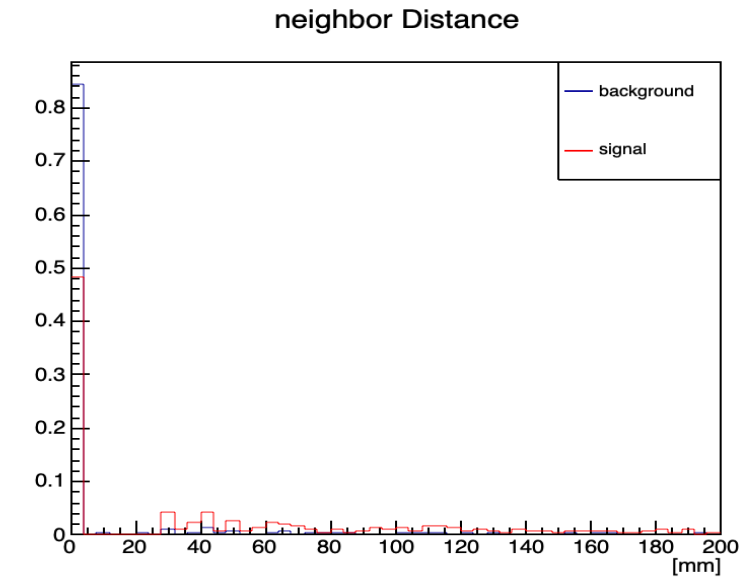
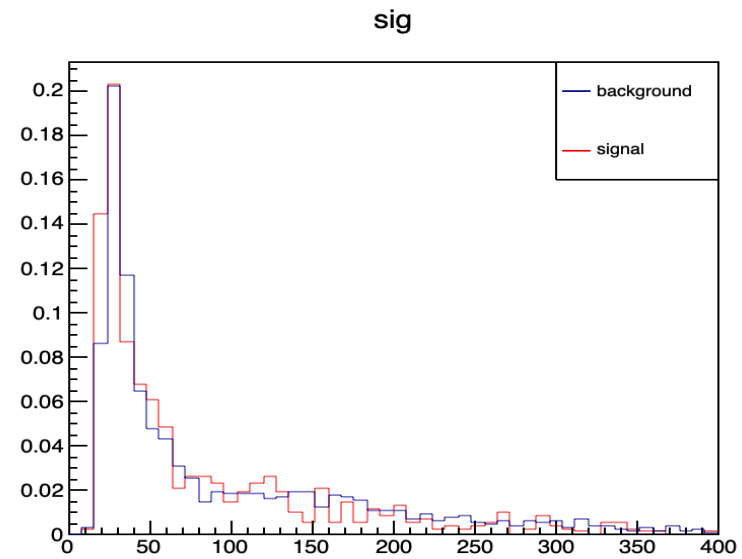
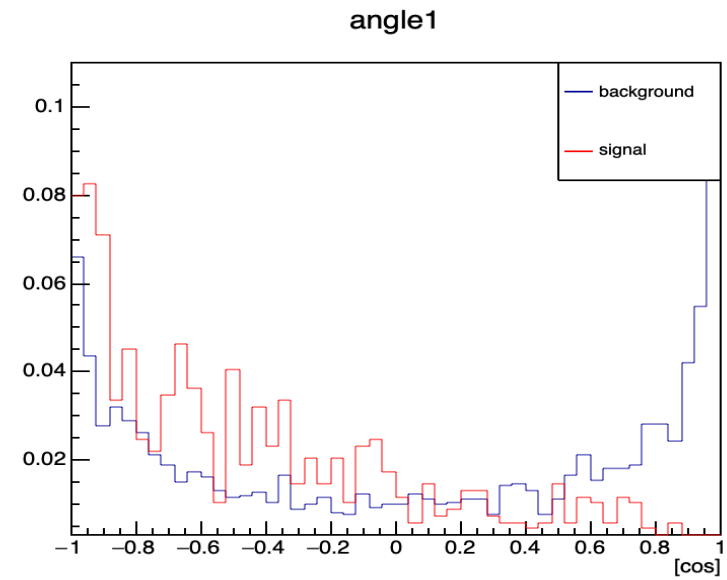
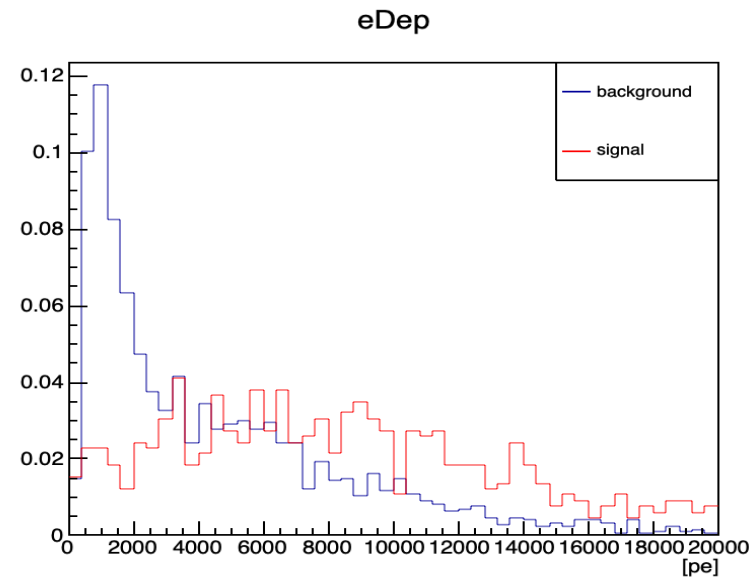
distance(second endpoint to first hit)



distance with closest track

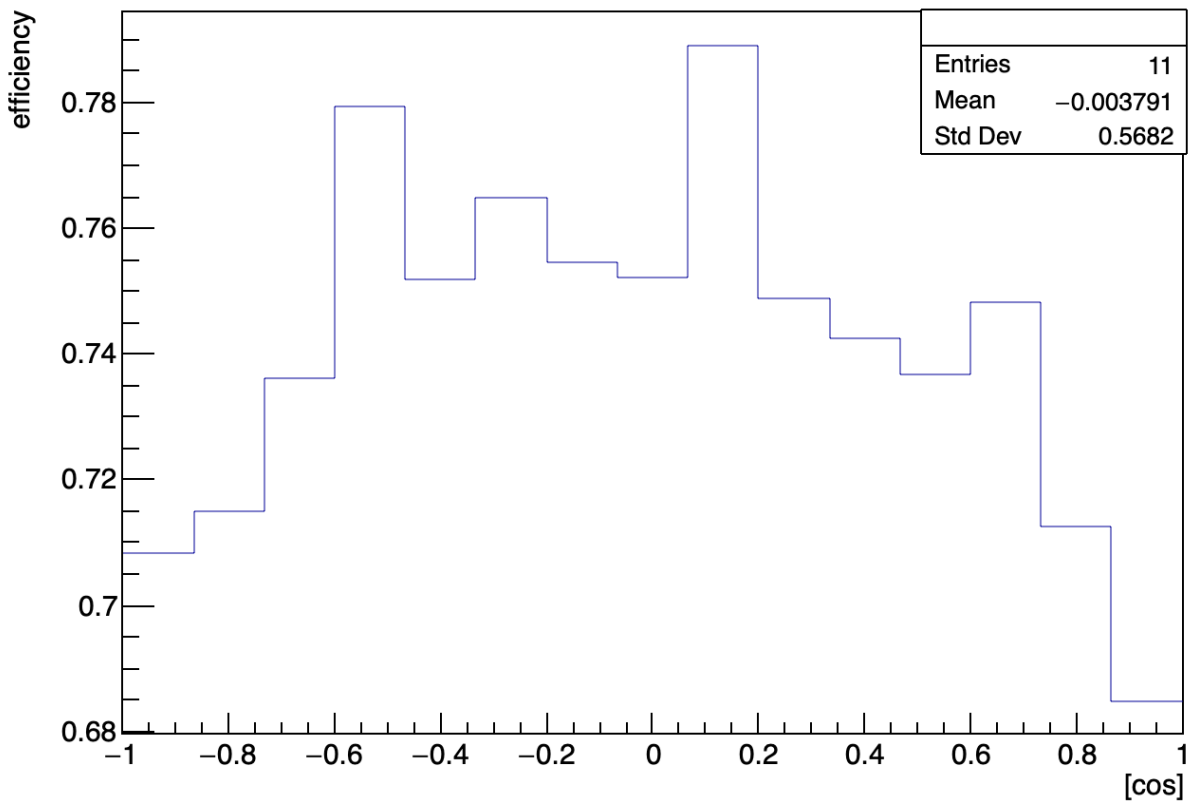


variables for track

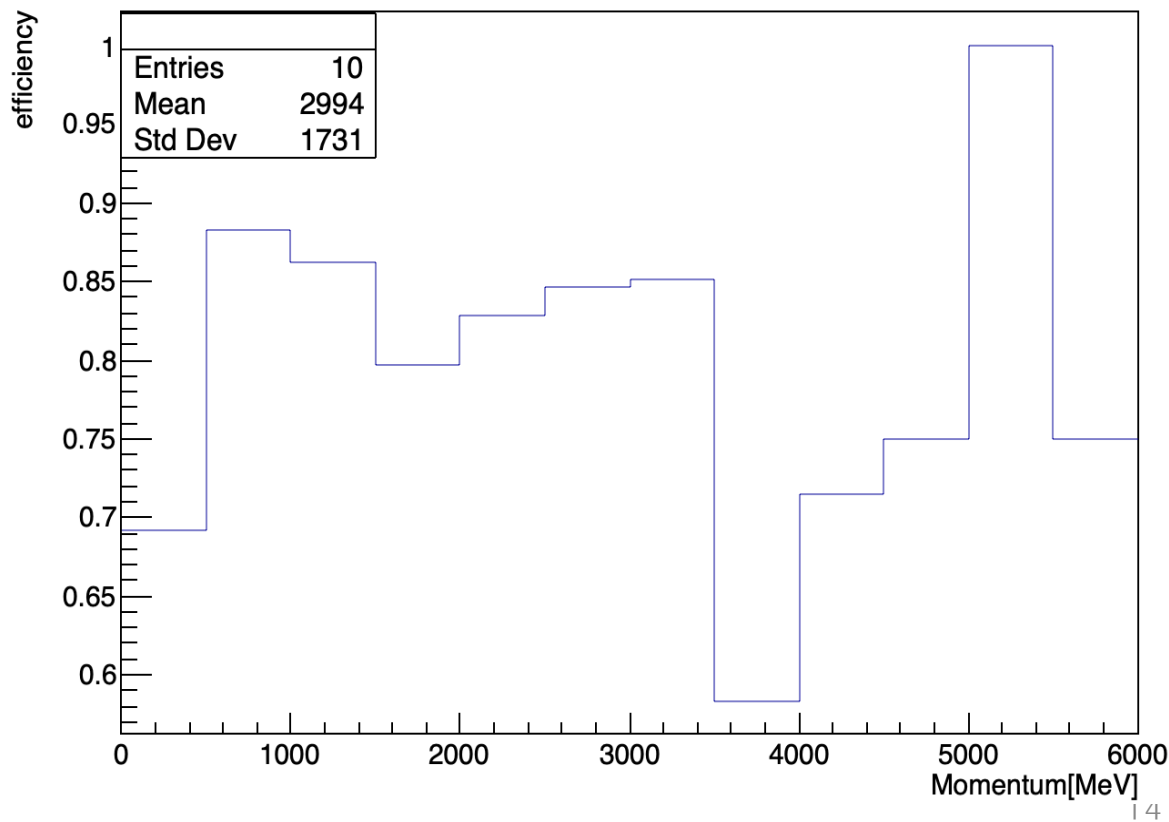


Phase space check after pion selection

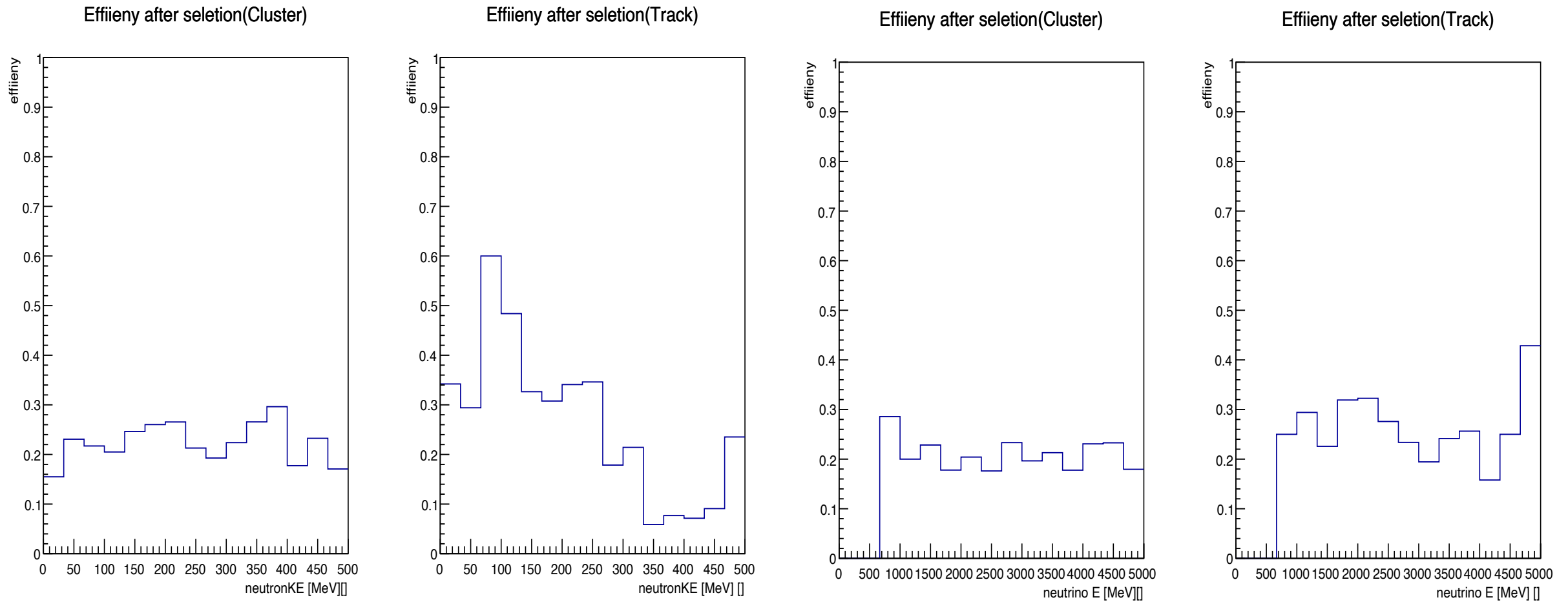
Charged pion track angle



Charged pion momentum



Phase space check after neutron selection



Phase space check after neutron selection

